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USCONARC
US ARMY
ARCTIC TEST BOARD

Fort Greely, Alaska



Report of
SERVICE TEST OF

WINTERIZATION KIT FOR

TRUCK, UTILITY, $\frac{1}{4}$ -TON, 4x4, M151

9 JUNE 1962

ATB 2-232

Date

Project Nr.

HEADQUARTERS
UNITED STATES CONTINENTAL ARMY COMMAND
Fort Monroe, Virginia

ATDEV-2

10 July 1962

SUBJECT: Report of Project Nr ATB 2-232, Service Test of
Winterization Kit for Truck, Utility, 1/4-Ton, 4x4, M151

TO: See distribution

1. Reference is made to letter, ATDEV-2 428, HQ USCONARC,
2 July 1962, subject as above, with inclosure.

2. Inclosed is a copy of Report of Project Nr ATB 2-232, "Winterization Kit for Truck, Utility, 1/4-Ton, 4x4, M151," US Army Arctic Test Board, 9 June 1962. It is requested that this report be substituted for the US Army Arctic Test Board Report of Project Nr ATB 102, "Radio Set AN/VRC-24," which was inadvertently forwarded as the inclosure to the above-referenced letter.

3. It is further requested that Reports of Project Nr ATB 102 be returned to this headquarters, ATTN: AG-ASB, with the least practicable delay.

FOR THE COMMANDER:



LEE L. STEWART
Colonel, AGC
Asst Adjutant General

1 Incl
Rept of Proj Nr ATB 2-232,
USAATBD, 9 Jun 62, subj
as above, w/anx A-D

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HEADQUARTERS
US ARMY ARCTIC TEST BOARD
APO 733, Seattle, Washington

REPORT OF PROJECT NR ATB 2-232
SERVICE TEST OF WINTERIZATION KIT FOR TRUCK, UTILITY, $\frac{1}{4}$ -TON, 4x4, M151

1. AUTHORITY:

a. Directive:

(1) Ltr, ATDEV-2, 428, Hq USCONARC, 9 October 1961, subject: "Service Test of the Winterization Kit for the Truck, Utility, $\frac{1}{4}$ -Ton, 4x4, M151."

(2) Ltr, ATDEV-2 428, Hq USCONARC, 3 November 1961, subject: "Service Test of the Winterization Kit for the Truck, Utility, $\frac{1}{4}$ -Ton, 4x4, M151."

b. Purpose: To determine the suitability of the Winterization Kit for the Truck, Utility, $\frac{1}{4}$ -Ton, 4x4, M151 for Army use under arctic winter conditions.

2. REFERENCES:

a. DA Project Nr: 546-09-020. RDB Technical Objective Nr: Unknown.

b. Reports of Equipment Failures Nr 1 through 41, Project Nr ATB 2-232, US Army Arctic Test Board.

c. OCTM Item 34266, 6 May 1952.

d. Plan of Test of Project Nr ATB 2-232, US Army Arctic Test Board, 23 January 1962, "Service Test of Winterization Kit for Truck, Utility, $\frac{1}{4}$ -Ton, 4x4, M151."

3. DESCRIPTION OF MATERIEL:

a. The Winterization Kit (test kit) for the Truck, Utility, $\frac{1}{4}$ -Ton, 4x4, M151 consists of an aluminum hardtop enclosure and a (-65°F) vehicle winterization kit. The test kit is designed to permit starting of the vehicle engine, satisfactory vehicle operation, and crew comfort at temperatures as low as -65°F.

b. The aluminum hardtop installation is a metal and glass enclosure designed to protect vehicle and crew from weather extremes and at the same time provide maximum crew comfort and vision. It is assembled and installed with common fasteners, bolts, nuts, and screws. Panels are of convenient size so the whole enclosure may be shipped knocked-down without excessive cubage requirements. The doors are equipped with sliding glass panels for ventilation and signaling. The enclosure is assembled with weather-resistant gaskets and is sealed to the basic vehicle body with similar material.

c. The (-65°) vehicle winterization kit consists of a gasoline burning crew compartment heater of the fresh air type, equipped with a windshield defroster, manual controls, and controls for heating the vehicle when unattended. Also, furnished in the kit is a standard slave receptacle installed on the right cowl, brush guard cover, an engine priming pump, insulation material for the vehicle floor and wheel housing panels, and a starter-detent control.

(1) The heater is a gasoline burning unit with a fresh air output of 30,000 BTU/hr and heated exhaust output of 20,000 BTU/hr. Fuel for the heater is drawn from the vehicle fuel tank by means of a separate electric fuel pump. Air for combustion is supplied by a blower contained in the heater. The same blower motor is used to circulate heated air inside the vehicle. The heater housing contains a damper and an electric damper-actuator which automatically diverts heated air to the battery compartment when actuated by a thermostatic switch located in the battery compartment. Temperature of the battery compartment is automatically regulated at all times when the heater is operating, regardless of other control settings. A "T" handle control on the heater housing is connected to the heater exhaust diverter valve. Pushing down on the "T" handle shifts the flow of exhaust from the outboard pipe system into the engine heating shroud where the hot gases escape between the edges of the shroud and the engine oil pan, heating the engine oil. Hot air defrosting is controlled by two valves, one located on the heater housing and one located on the dash panel.

(2) The electric slave receptacle provides a means of starting the vehicle with a service cable connected to an external 24-volt power source when the engine cannot be started otherwise.

(3) An engaging detent for the starter drive is mounted on the engine flywheel housing and is operated by a cable control located on the dash panel. In extreme cold the starter drive gear may not slide to engage the engine flywheel; under these conditions, the detent control allows the driver to free the gear for normal starter engagement.

(4) The brush guard cover and flap control the flow of cold air through the radiator and protects the engine from wind-blown snow. The flap can be opened to admit air for cooling the engine or closed to assist in maintaining normal engine operating temperature.

(5) An engine priming pump is installed on the dash panel and connected to priming fittings in the intake manifold. Fuel for the priming system is taken through a shut-off valve in a feed line from the heater fuel pump. The priming pump is provided as a means of supplementing the carburetor choke when starting the engine in extreme cold.

(6) Insulation material is glued to the floor, the battery compartment cover, the top of the fuel tank, and the wheel housings to assist in retaining heat in the crew and battery compartments.

d. One complete winterization kit was received on 28 September 1961. A maintenance package was provided for the test kit on 12 October 1961.

e. Descriptive photographs of the test kit are shown in Annexes C.1 and C.2.

4. BACKGROUND:

a. A requirement for the test winterization kit is stated in reference 2c.

b. Engineering tests have not been conducted on the test winterization kit.

c. The test kit was a pre-production model furnished the US Army Arctic Test Board for service test.

d. Information concerning tripartite standardization is not available.

5. SUMMARY OF TEST RESULTS: Tests were conducted by Major William T. Mahaffey, Armor, and other personnel of Test Division 2, US Army Arctic Test Board, utilizing plan of test, reference 2d.

a. General:

(1) During winter testing, test personnel were dressed in appropriate arctic winter clothing including the Arctic Mitten Set.

(2) All tests were concerned only with the suitability of the test kit, except for those operations in which installation of the test kit components affected adversely the suitability of the M151 or in which the components of the M151 adversely affected the suitability of the test kit components, and for comparison of cold starts with and without the test kit.

(3) The test kit was subjected to as wide a range of temperature and weather conditions as were available. Performance data were obtained at temperatures as low as -62°F. During the conduct of all tests, ambient temperatures and weather conditions existing prior to, during, and after applicable phases of each individual test were recorded.

(4) When not being used in operational tests, the test kit, installed on the M151 truck, remained outdoors in unsheltered areas except for those periods when maintenance indoors was required.

(5) For all tests, operation and servicing of the test kit was in accordance with instructions contained in TB 9-2320-218-10/1, TB 9-2320-218-20/1, and TM 9-2320-218-20.

(6) Certain characteristics of a winterized M38A1 $\frac{1}{4}$ -ton truck including a Model 978-MH gasoline personnel heater and a Model 480 gasoline power plant heater were compared with similar characteristics of the personnel heater, Model 1030-D24, mounted as part of the test kit in the M151 $\frac{1}{4}$ -ton truck. Comparisons were made as indicated in Test Nr 2.

(7) The test kit was satisfactory with regard to maintenance.

(8) The test kit was unsatisfactory with regard to the following:

- (a) Functional and operational suitability.
- (b) Compatibility with related equipment.
- (c) Ease of operation, comfort and safety.
- (d) Durability and reliability.

b. Test Nr 1 - Installation, Preoperational Inspection and Physical Characteristics

(1) The test kit was given a complete inspection as outlined in MWO 9-2320-218-30/2, TB 9-2320-218-10/1, TM 9-2320-218-20, and TB 9-2320-218-20/1. Defects discovered during the inspection and installation included broken glass in both door panels, ineffective seals for the top and side panels of the hardtop enclosure; defective fuel pump, damper actuator assembly, flame detector switch, and fuel control valve for the personnel heater.

(2) The Truck, Utility, $\frac{1}{4}$ -Ton, 4x4, M151 was given a complete inspection as outlined in TM 9-2320-218-20 and was found to be in serviceable condition.

(3) The test kit weighed 254 pounds. Dimensions of the M151 with the test kit installed were as follows:

- (a) Length of vehicle with kit installed - 132 inches.
- (b) Width of vehicle with kit installed - $62\frac{1}{4}$ inches.
- (c) Height of vehicle with kit installed - 69 inches.

c. Test Nr 2 - Functional and Operational Suitability:

(1) After various cold-soak periods, the engine of the M151 vehicle was cold started without preheat during ambient temperatures ranging from -1°F to -52°F . After similar cold-soak periods at temperatures ranging from 5°F to -62°F , the engine was started after preheat. A comparison of engine cranking times and the time for the engine coolant to reach 140°F revealed that the engine started as well with as without preheat during temperatures as low as -52°F and could not be started below -52°F without preheat. During these temperatures, the engine cranked easier with preheat than without; however, the crank-to-start time was not reduced.

(2) The preheat facility of the test kit was more dependable than the power plant heater of the M38A1.

(3) The test kit personnel heater would not distribute heat evenly in the crew compartment. Temperature of the air in the rear seat area averaged 30°F lower than that of the center of the vehicle, and an uncomfortable amount of heat was directed to the driver's right leg and assistant driver's left leg.

(4) The test kit personnel heater was capable of raising the temperature of the air in the center of the vehicle from -38°F to 78°F in 15 minutes.

(5) The damper actuator diverted hot air to the battery compartment and raised the compartment air temperature from -30°F to 95°F in 15 minutes. During this period, the temperature of the battery electrolyte increased from -30°F to 55°F .

(6) The defroster would not remove ice from the outer surface of the windshield, and would not completely defrost the inner surface of the windshield.

(7) The average fuel consumption of the personnel heater in the test kit was 0.38 and 0.27 gallons per hour when the heater was operated on high and low heat, respectively.

(8) The starter drive detent control assembly was capable of manually engaging the starter drive gear with the engine flywheel gear. Use of the assembly was required only one time during the test.

(9) The engine priming system was not required and was not used.

(10) A comparison of the hardtop enclosure of the test kit and that of an M38A1 $\frac{1}{4}$ -ton truck revealed the following:

(a) Heat loss in the test kit was greater than in the M38A1.

(b) Frost collected on the inner panels of the test kit but, did not collect on the inner surfaces of the M38A1 because the M38A1 panels were insulated with thermal barrier material.

(c) The door glass was easier to open and close on the M38A1.

(d) Visibility was better in the test kit.

(e) The doors and panels on the test kit were better sealed.

(f) The door hinges of the test kit were not as durable as those on the M38A1.

(11) The flap on the brush guard cover froze and appeared to shrink at ambient temperatures below -10°F and the flap could not be fastened to the pre-positioned snap fasteners.

d. Test Nr 3 - Compatibility with Related Equipment: The M151 was compatible with the test kit. The test kit was compatible with the M151 except as follows:

(1) The defrosters could not completely defrost the windshield and broke the windshield on three occasions.

(2) The installation of the fresh air intake hose in the rear of the vehicle decreased passenger and cargo space.

(3) The hood cover was not provided with an access hole over the hook on the hood.

(4) Insulation material for the transmission provided with the test kit had been incorrectly pre-cut and could not be installed.

e. Test Nr 4 - Ease of Operation, Comfort and Safety:

(1) All controls and switches could be operated with or without the Arctic Mitten Set.

(2) The following were considered difficult:

(a) The doors could not be pulled closed and latched without first turning the inner door handle.

(b) The door glass panels, where they overlap at the center, were difficult to clean.

(c) Conversation between the driver and personnel outside the vehicle was made difficult as the driver could not hear above the roar of the air rushing into the fresh air intake.

(3) The personnel heater directed an uncomfortable amount of hot air on the driver's right leg and assistant driver's left leg.

(4) There were no objectionable odors attributed to the operation of the personnel heater.

(5) Safety hazards developed because the defrosters could not completely remove frost from the windshield; the door glass panels slid open during in-transit operation; and the doors came open unexpectedly.

(6) Operating instructions contained in TB 9-2320-218-10/1 were adequate for arctic operations.

f. Test Nr 5 - Maintenance:

(1) A total of 37.26 man-hours was expended in maintenance of the test kit for 10,899 miles of vehicle operation.

(2) On-vehicle (M151) and organizational tools were adequate for the performance of first and second echelon maintenance, respectively.

(3) The only difficult operation encountered concerned the damper actuator which could not be adjusted without technical assistance from the manufacturer.

(4) The publications included in the maintenance package were adequate with the exception of floor drilling instructions for the installation of the personnel heater.

(5) There were no replacement parts used for the maintenance of the test kit; however, three vehicle windshield glasses were replaced because the defrosters directed excessive heat to a small area on the windshield.

g. Test Nr 6 - Durability and Reliability: The test kit-vehicle combination was driven 10,899 miles and the personnel heater was operated for 575 hours during all types of weather and during ambient temperatures

ranging from 21°F to -62°F. The durability of the doors and the reliability of the door latches were considered inadequate. An average of one man-hour of maintenance was expended for each 400 miles of operation.

6. DISCUSSION:

a. The engine of the M151 was started without a requirement to use the starter drive detent control for all cold starts, after cold-soaks for periods ranging from 2 to 71 hours during ambient temperatures ranging from 5°F to -62°F with the exception of one occasion after the test kit-vehicle combination had been cold-soaked for 12 hours, during ambient temperatures ranging from -47°F to -54°F. This one-time requirement may have been an isolated instance. This feature will be rechecked during the retest of the kit during the 1962-1963 test season and appropriate recommendations included in the report of test.

b. The engine priming system was not required and was not used for cold starting the vehicle engine during any of the cold starts outlined in paragraph a above.

7. CONCLUSIONS: It is concluded that:

a. The Winterization Kit for the Truck, Utility, $\frac{1}{4}$ -Ton, 4x4, M151 requires modification as indicated in Annex B in order to make it suitable for Army use under arctic winter conditions.

b. The engine priming system is non-essential for use with Winterization Kit for the Truck, Utility, $\frac{1}{4}$ -Ton, 4x4, M151 under arctic winter conditions.

8. RECOMMENDATIONS: It is recommended that:

a. The deficiencies, and as many of the shortcomings as possible, listed in Annex B be corrected.

b. A modified Winterization Kit for the Truck, Utility, $\frac{1}{4}$ -Ton, 4x4, M151 be provided this Board for additional test.

c. The engine priming system not be included as a component of the test kit.



HENRY E. DAVIDSON, JR.

Colonel, Armor
President

ANNEXES:

- A - Details of Test
- B - Findings
- C - Photographs
- D - Coordination of Plan

DISTRIBUTION:

- 40 - CG, USCONARC
- 2 - Ch, R&D Off, Alaska, AP0 731
- 3 - Board file

ANNEX A -- DETAILS OF TEST

REPORT OF TEST - PROJECT NR ATB 2-232

Test Nr 1 - Installation, Preoperational Inspection and Physical Characteristics:

1. PURPOSE:

- a. To determine whether the test kit was in proper condition for test.
- b. To determine the physical characteristics of the test kit.

2. METHOD:

a. Prior to initiation of testing, the test kit was installed on an M151 $\frac{1}{4}$ -ton truck in accordance with instructions contained in MW0 9-2320-218-30/2. During installation, the test kit was inspected for damaged, unserviceable, or incomplete components. After installation, components of the test kit were operated and inspected as outlined in TB 9-2320-218-10/1 and TB 9-2320-218-20/1. The M151 $\frac{1}{4}$ -ton truck was given a technical inspection as outlined in TM 9-2320-218-20. Damaged, unserviceable, incomplete, and inoperative components of the test kit were repaired and reported.

b. The test kit was weighed before installation, and was measured and photographed after being installed on the M151 and examined for unusual characteristics. Weights and dimensions were recorded.

3. RESULTS:

a. A maintenance package was not provided with the test kit (Test Nr 5).

b. Inspection during installation revealed the following:

(1) The glass in the right and left doors were cracked upon receipt of material (par 1, Annex B).

(2) The floor drilling instructions outlined in MW0 9-2320-218-30/2 were incorrect. A correct drilling diagram was prepared (Test Nr 5).

(3) The fuel pump and the fuel filter could not be mounted on the bracket provided (par 18, Annex B).

(4) The control pin on the exhaust diverter assembly was broken (par 19, Annex B).

(5) The door plunger control shaft in the left door broke during installation (par 20, Annex B).

(6) A hole was not provided in the hood cover so that the hood could be locked in the open position (Test Nr 3).

(7) The hood could not be raised without first unsnapping the fasteners on the top of the brush guard (Test Nr 4).

(8) The pre-cut insulating material provided for the transmission cover could not be installed because the material was incorrectly cut (Test Nr 3).

(9) The assistant driver's seat, when tilted forward, crushed the ducting from the heater to the dash defroster assembly (Test Nr 5).

(10) The weather seal strips provided with the test kit did not seal the top panel to the side and rear panels of the hardtop enclosure (Test Nr 2).

(11) The bottom cap on the heater fuel pump was damaged and could not be installed on the pump. The braided lead wire on the fuel pump was unserviceable (par 23, Annex B).

c. During pre-test operational checks of the personnel heater, the following component failures were noted:

(1) The flame detector switch failed to turn the heater off (par 24, Annex B).

(2) The fuel control valve would not meter sufficient fuel to the combustion chamber when the heater was set for high heat output (par 25, Annex B).

(3) The damper actuator solenoid burned out because of a faulty switch in the terminal assembly block (par 5, Annex B). The solenoid failure could have been prevented had a circuit breaker been provided in the circuit (Test Nr 6).

d. Pre-test operation of the door latches and door glass revealed the following failures:

(1) Sliding the door glass in the felt-lined glass channels caused the felt material to loosen and jam against the glass (Test Nr 6).

(2) The door latch plungers did not automatically engage the door pillar striker plates when the doors were pulled closed. The latch plunger had to be retracted into the door, the door closed, and the plungers released (Test Nr 4).

e. The dimensions and weight of the winterization kit were as follows:

- (1) Length of M151 with winterization kit - 132 inches.
- (2) Width of M151 with winterization kit - $62\frac{1}{4}$ inches.
- (3) Height of M151 with winterization kit - 69 inches.
- (4) Weight of M151 with winterization kit - 2,380 pounds.
- (5) Weight of winterization kit - 254 pounds.

f. The test kit had no unusual characteristics other than the provisions of using the exhaust gasses from the personnel heater to pre-heat the engine of the M151.

Test Nr 2 - Functional and Operational Suitability:

1. PURPOSE:

a. To determine whether the test kit was suitable for Army use with the M151 $\frac{1}{4}$ -ton truck.

b. To determine whether components of the test kit suitably performed required functions separately and when operated with other components of the test kit.

2. METHOD: The test kit was operated and components observed with regard to adequacy of performance as indicated below. Based on the results, the over-all suitability of the test winterization kit was evaluated.

a. Cold-Starting: Prior to the conduct of the following tests, the M151 $\frac{1}{4}$ -ton truck with the test kit installed was cold-soaked for various periods and at various ambient temperatures. The vehicle batteries were brought to full charge prior to the start of any cold-soak period.

(1) For comparison purposes, attempts were made to start the vehicle with, and without, application of features of the test kit. All such attempts were made at comparable ambient temperatures and following comparable cold-soak periods.

(2) Attempts to start the vehicle at temperatures above -25°F were made without the use of any facilities of the test winterization kit, except as noted in (1) above.

(3) At temperatures below -25°F , and except as noted in (1) above, the vehicle was started using the test kit as follows: The flap was closed on the brush guard cover; the personnel heater was operated on the

high heat range with the heater exhaust gases diverted to the engine oil pan for periods of 15 minutes prior to initial engagement of the starter. If the engine failed to start, preheat was continued for an additional 15 minutes. Heating of the engine oil pan was not extended beyond 30 minutes. The choke was closed (full choke), and the hand throttle was locked in the 1/3-open position. Before engaging the starter, the accelerator pedal was fully depressed three times, and the ignition switch was turned to the on position. After the engine started, the choke was gradually opened. After the engine coolant reached 140°F, the hand throttle was released.

(4) In each cold start test, the following were recorded:

- (a) Ambient temperatures during the cold-soak period and prior to attempted start.
- (b) Length of cold-soak period prior to attempted start.
- (c) Length of preheat time.
- (d) Length of cranking time required to start engine.
- (e) Length of time for engine coolant to reach an operating temperature of 140°F.
- (f) Priming required, if any.

(5) Similar cold start tests were conducted using the M38A1 $\frac{1}{4}$ -ton truck and its power plant heater, as appropriate. The results of these tests were compared with those obtained with the test kit and evaluated to determine if a power plant heater would be more advantageous than the hot-air facility provided with the test kit.

b. Heating of the crew compartment and operation of defrosters: The personnel heaters and defrosters of the test kit and those of the control M38A1 were operated during low ambient temperatures. An evaluation was made to determine which of the two systems would be most desirable for use in the M151 $\frac{1}{4}$ -ton truck.

(1) After selected cold-soak periods, as indicated in subparagraph 2a above, the personnel heater was activated. Prior to, during, and at the end of each test period as appropriate, the following were recorded:

- (a) Ambient temperatures (°F).
- (b) Crew compartment temperatures at the following locations:
 - 1. Top center of windshield.
 - 2. Center of the vehicle, midway between the floor and the roof.

3. On the center of the rear seat.
- (c) Degree of frost and/or ice on the windshield.
- (d) Degree of frost on the interior of the hardtop enclosure.
- (e) The time required during a one hour period or portion thereof, to raise the temperature in the center of the crew compartment in 15°F increments. Associated temperatures at the top center of the windshield and at the top center of the rear seat were also recorded.

(2) During all usage, the operation of the personnel heater was observed and the following data recorded:

- (a) Whether heater was operating on Hi or Lo heat.
- (b) Ambient temperature and crew compartment temperatures ((1)(b) above) prior to and periodically during vehicle operation.
- (c) Capability of the defroster to keep the windshield free of ice or frost.
- (3) During heater operations, appropriate data were recorded and used to compute the heater fuel consumption per hour of operation with the heater set on Hi and again with the heater set on Lo heat.

c. Hardtop enclosure. A comparison of the hardtop enclosure on the test kit and that on the control M38A1 was made to determine if similar components of the control M38A1 enclosure were more suitable than those of the enclosure of the test kit. The following features were compared and the results recorded:

(1) Doors, door latches, door glass assemblies, body seals, and insulation material.

(2) Visibility afforded.

d. The slave receptacle was utilized to determine its ability to transfer current from an external 24-volt source to the vehicle electrical system. Results were recorded.

e. The starter drive detent was utilized to manually slide the starter drive gear into mesh with the flywheel gear when the starter failed to do so automatically. Results were recorded.

3. RESULTS:

a. Cold start tests with the test kit-M151 vehicle combination. The test kit-vehicle combination was cold-soaked for periods of 2 to 71 hours

during ambient temperatures ranging from 5°F to -62°F. After cold-soak periods indicated below, the engine was started with and without preheat. The engine priming system was not required and was not used (par 36, Annex B). Results indicated that the engine could be started at ambient temperatures as low as -52°F without preheat but that preheat was required below -52°F. Representative tests and results are listed below:

	<u>Ambient Temperature (°F)</u>	<u>Cold-Soak</u>	<u>Pre-heat</u>	<u>Cranking Time</u>	<u>Time for Engine Coolant to Reach 140°F (Minutes)</u>
	<u>At Cold Start</u>	<u>(Hours)</u>	<u>(Minutes)</u>	<u>(Minutes)</u>	
A	5 to -25	5	71.0	15	0.53
B	-2 to -8	-4	15.0	None	0.04
C	-2 to -12	-8	6.2	None	0.04
D	-1 to -24	-24	16.0	15	0.15
E	-31 to -39	-39	3.5	15	0.05
F	-34 to -40	-36	4.0	None	0.13
G	-41 to -47	-43	11.2	15	0.05
H	-47 to -48	-47	6.0	15	0.07
I	-43 to -51	-51	7.0	None	0.08
J	-41 to -52	-52	31.6	None	0.65
*K	-49 to -60	-52	16.0	15	0.11
*L	-47 to -54	-52	12.0	15	0.20
*M	-49 to -53	-53	15.5	10	0.75
**N	-48 to -62	-62	17.0	30	0.95
					16.00

*Engine would not start without preheat.

**Engine would not start after 15-minute preheat.

b. Results of cold start tests with the M38A1 equipped with a hot water power plant heater compared to those obtained with the test kit-M151 combination revealed that the preheat facility of the test kit was more dependable than the power plant heater on the M38A1:

(1) As an average, it required 20 minutes to start the M38A1 power plant heater at ambient temperatures below -25°F. On two occasions, first at an ambient temperature of -34°F, and again at -47°F, the power plant heater could not be started and the M38A1 control vehicle had to be towed to start.

(2) During a test the M151 with test kit required a total of 21.50 minutes to reach operating temperature as compared to 37.80 minutes for the control M38A1 with power plant heater. For this test, both vehicles were cold-soaked for 3.5 hours at ambient temperatures ranging from -24°F to -39°F:

<u>Vehicle</u>	<u>Time To Start Heater (Minutes)</u>	<u>Preheat Time (Minutes)</u>	<u>Cranking Time (Minutes)</u>	<u>Time Engine Coolant Reached 140°F (Minutes)</u>	<u>Total Time (Minutes)</u>
M38A1	15.00	15.00	0.50	7.30	37.80
M151	00.50	15.00	0.05	5.87	21.50

c. The test kit personnel heater would not distribute heat evenly within the crew compartment. The diverter assembly directed an uncomfortable amount of heat on the driver's right leg and the assistant driver's left leg (Test Nr 4). As an average, the temperature at the rear seat was 30 degrees lower than the temperature in the center of the crew compartment. The following representative test was conducted after a cold-soak of eight hours and reflects the heat distribution in the crew compartment. The test was conducted during ambient temperatures ranging from -32°F to -62°F with the personnel heater on Hi heat, with heat directed to the crew compartment and defroster and with the vehicle traveling at 25 mph.

<u>Elapsed Time (Hours)</u>	<u>Ambient Temperature (°F)</u>	<u>Crew Compartment Temperatures (°F)</u>		
		<u>Windshield</u>	<u>Center</u>	<u>Rear Seat</u>
0	-32	-28	-31	-26
0.25	-32	58	88	3
1.50	-57	64	73	46
2.50	-60	62	77	41
3.50	-60	62	76	40
4.50	-61	60	77	44
5.50	-61	62	79	50
8.50	-62	64	78	42
9.50	-62	64	76	42
10.50	-61	64	75	48
12.50	-59	61	74	49
13.50	-59	64	76	50
14.50	-58	63	76	51

d. The capability of the test kit personnel heater to heat the crew compartment of the M151 was superior to that of the personnel heater in the control M38A1. After a cold-soak of 16 hours, comparative data of two representative tests were recorded showing the heat rise in consecutive 15-minute time intervals. Results of the tests are listed in (1) and (2) below:

(1) Vehicles traveling at 25 mph:

<u>Elapsed Time (Minutes)</u>	<u>Ambient Temperature (°F)</u>	<u>Temperatures (°F)</u>					
		<u>Ctr of Veh</u>	<u>Top Windshield</u>	<u>Rear Seat</u>	<u>M151</u>	<u>M38A1</u>	<u>M151</u>
<u>Heater on High Heat</u>							
0	-24	-23	-23	-23	-23	-23	-23
15	-24	76	25	68	30	37	22

Elapsed Time (Minutes)	Ambient Temperature (°F)	Temperatures (°F)					
		Ctr of Veh		Top Windshield		Rear Seat	
M151	M38A1	M151	M38A1	M151	M38A1	M151	M38A1
30	-24	62	56	76	51	36	20
45	-21	62	46	86	55	37	24
60	-21	63	38	88	39	37	23

Heater Reset to Low Heat							
75	-21	50	32	41	28	34	21
90	-20	51	30	41	26	35	19
105	-20	50	29	39	26	35	18
120	-20	50	29	39	26	35	18

(2) Vehicles traveling at 20 mph, heater on high heat:

0	-39	-38	-38	-38	-38	-38	-38
15	-39	78	22	48	22	9	0
30	-50	69	45	46	50	34	20
45	-50	71	43	48	50	34	23
60	-50	74	42	51	49	44	22
75	-50	76	39	51	45	45	18
90	-51	79	40	54	45	45	20
105	-54	79	41	52	46	44	20
120	-54	74	38	51	43	43	20

e. During ambient temperature of -4°F with a wind velocity of 35 to 60 mph, vehicle parked, with the personnel heater of the test kit on Hi, and the defroster off, a test was conducted to determine the time required to raise the temperature of the air in the center of the vehicle in increments of 15°F. The test was stopped after 9.4 minutes to prevent breaking the test thermometer. Results of the test are listed below:

Elapsed Time (Minutes)	Temperature (°F)		
	Center	Windshield	Rear Seat
0.00	-2	-2	-2
1.42	13	8	0
2.72	28	12	0
3.05	43	18	3
4.08	58	32	11
6.12	73	42	11
9.40	88	60	16

f. Difficulty was experienced with the operation of the damper actuator assembly of the heater in the test kit (Test Nr 6). After the assembly was adjusted by the factory representative, the actuator was effective in automatically diverting heated air to the battery compartment and also automatically actuating the damper valve shutting off the heated air after the temperature in the battery compartment reached 95°F. Results

of a representative test conducted after the test kit-vehicle combination had been cold-soaked 34.5 hours during ambient temperatures ranging from -9°F to -33°F are listed below:

<u>Elapsed Time (Minutes)</u>	Temperatures (°F)		
	Amb	<u>Battery Compartment</u>	<u>Electrolyte</u>
0	-25	-30*	-30
15	-25	95**	55

*Actuator automatically opened damper to battery compartment.

**Actuator automatically closed damper.

g. Comparisons of the defrosting capabilities of the heaters in the test kit and the M38A1 revealed that the defrosters in the test kit were more effective in removing frost and keeping the windshield relatively frost free than those of the M38A1; however, the defrosting capability of the test kit was unsatisfactory as indicated below:

(1) At ambient temperatures ranging from 21°F to 15°F while driving in a light falling mist, and again while driving through light falling snow, 0.13-inch ice formed on the outer surface of the windshield and had to be repeatedly removed with a hand scraper.

(2) At ambient temperatures ranging from -20°F to -62°F, the defrosters were not capable of completely defrosting the windshield.

(3) It was determined that the glass door panels, where they over-lap each other, had to be sealed with a piece of 5/16-inch sponge rubber to prevent the outside windstream from creating a suction and drawing the hot air away from the windshield. While this locally applied modification improved defroster action, only one-third of the windshield remained frost free at temperatures ranging from -46°F to -62°F (par 10, Annex B).

h. The average fuel consumption of the personnel heater in the test kit was 0.38 and 0.27 gallons per hour when the heater was operated on high and low heat, respectively. Results of six tests are listed below:

<u>Ambient Temperature (°F)</u>	<u>Vehicle (MPH)</u>	<u>Heat Position</u>	<u>Fuel Consumption (Gallons per Hour)</u>
-12 to -23	25	Hi	0.390
-12 to -23	25	Hi	0.362
-12 to -23	25	Hi	0.380
-12 to -23	25	Lo	0.304
-1 to -29	25	Le	0.238
-1 to -29	25	Lo	0.276

i. A comparison of the hardtop enclosure on the test kit and that of the M38A1 was made with the following results:

(1) At ambient temperatures below -44°F, heavy frost collected on the inner surfaces of the aluminum roof, side, and rear panels of the test kit enclosure. The frost could not be removed by varying the positions of the fresh air damper or by operating the heater on high or low heat (par 28, Annex B). Frost did not form on the M38A1 panels.

(2) The M151 did not have thermal barrier insulation applied to the top, side, and rear panels. The M38A1 panels were insulated with a thermal barrier material, and heat loss was not as rapid as that in the M151 (par d above).

(3) The door hinges on the M151 were not as durable as those on the M38A1. The hinges on the M151 broke loose from the aluminum doors (Test Nr 6).

(4) The door glass on the M38A1 was easier to open and close than that of the M151. The handles fell off the door glass of the M151 (Test Nr 6).

(5) Visibility was better in the M151 than in the M38A1.

(6) The doors and panels were better sealed on the M151 than on the M38A1; however, the seal material between the panels on the M151 did not completely seal the top, side, and rear panels together (par 4, Annex B).

(7) The use of straps to fasten the flap on the radiator brush guard cover of the M38A1 was more functional than the snap stud fastener provided for the flap of the M151. At ambient temperatures below -10°F, the flap on the brush guard of the M151 froze and appeared to shrink and the flap could not be fastened to the pre-positioned snap stud fastener (par 31, Annex B).

j. The slave receptacle was capable of transferring current from the batteries in the M151 through a slave cable to the M38A1 $\frac{1}{4}$ -ton, M135 and M211 $2\frac{1}{2}$ -ton trucks.

k. Use of the starter drive detent control was required one time during the 10,899 miles of the test. This one-time requirement was considered an isolate instance. The starter drive detent was capable of engaging the starter drive gear with the flywheel gear.

Test Nr 3 - Compatibility with Related Equipment:

1. PURPOSE: To determine the compatibility of the test winterization kit with the Truck, Utility, $\frac{1}{4}$ -Ton, 4x4, M151.

2. METHOD: Throughout all tests, observations were made with respect to any interference of the test kit with the operation of the M151, and any operation of the M151 which interfered with the operation of components of the test kit. Results of the following observations were recorded:

a. Effect of heater or preheat operations on state of charge of battery.

b. Whether installation of the test kit affected cargo capacity, passenger capacity, and entrance and exit of passengers.

3. RESULTS

a. Operation of the heater had no harmful effect on the state of charge of the vehicle battery. The heater was capable of raising the temperature of the battery electrolyte from -30°F to 55°F within 15 minutes, thereby increasing the potential electrical capacity of the battery at low ambient temperatures (Test Nr 2).

b. The installation of the air intake hose from the left side of the M151 to the rear of the personnel heater restricted the available cargo and passenger space in the rear of the vehicle. The hose was repeatedly kicked loose from the adaptor on the rear of the heater by personnel entering or leaving the rear seat compartment (par 30, Annex B).

c. The defrosters diverted excessive amounts of hot air on the windshield panels at the defroster outlet and cracked the windshield glass on three separate occasions as described below (par 11, Annex B):

(1) After a cold-soak of 10 hours during ambient temperatures ranging from -15°F to -34°F, the engine was started using the personnel heater exhaust gases to preheat the engine for 15 minutes. After preheating and starting the engine (heater on Hi heat), the defrosters were turned on, and after five minutes of cross-country travel, a two-inch crack appeared at the bottom center of the right windshield.

(2) After the vehicle had been operated for 12 hours at ambient temperatures ranging from 19°F to 0°F, the defrosters were turned on (heater on Lo, vehicle parked), and within ten minutes a three-inch crack appeared at the bottom center of the right windshield.

(3) After a cold-soak of ten hours during ambient temperatures ranging from -50°F to -56°F, the vehicle was operated with the defrosters off for 0.5 hours; then with the heater on Hi heat and the defrosters on, a two-inch crack appeared in the bottom center of the left windshield after one hour of highway operation.

d. The hood cover provided was not compatible with the M151 hood, as an access hole had not been provided for the hood latch hook in the front center of the hood (par 21, Annex B).

e. There were no features of the M151 vehicle which adversely affected the operation of switches or controls of the test kit.

f. The pre-cut insulation material provided with the test kit for the transmission cover was incorrectly cut and could not be installed (par 22, Annex B).

Test Nr 4 - Ease of Operation, Comfort and Safety:

1. PURPOSE:

a. To determine if the test kit could be readily operated.

b. To determine whether the test kit had any features which adversely affected the comfort and safety of the passengers.

2. METHOD: Throughout all testing, the test kit was operated in accordance with instructions contained in TB 9-2320-218-10/1 and observations were made with respect to any difficulties experienced in operation of components of the test kit, discomforts suffered by the crew and passengers, and any safety hazards encountered. The following were observed, and results were recorded

a. Whether the manipulation of control switches, defroster controls, and exhaust diverter controls could be easily accomplished and whether switches and controls could be operated while wearing the Arctic Mitten Set.

b. Whether the slave receptacle, starter detent control, brush guard flap, and hood snaps could be easily manipulated with and without the Arctic Mitten Set.

c. Any objectionable odors in the crew compartment to include heater exhaust gases as the result of personnel heater operation.

d. Any discomforts experienced because of lack of ventilation, uneven distribution of heat, or poor visibility.

e. Any safety hazards experienced in the operation of the components of the test kit.

f. Adequacy of instructions for arctic operations.

3. RESULTS:

a. All controls and switches could be operated with or without the use of the Arctic Mitten Set.

b. The door latch plungers were difficult to operate because they did not automatically slide into the latch striker plates when the doors were closed. It was necessary to recess the latch plunger into the door by turning the inside door handle, holding the handle with plunger recessed, closing and pulling the door against the door opening, then turning the handle to latch the door (par 7, Annex B).

c. The door glass panels were difficult to clean because they overlapped each other $1\frac{1}{2}$ inches (par 27, Annex B).

d. The flap on the brush guard cover could not be fastened with or without the Arctic Mitten Set at ambient temperatures below -10°F because the flap became frozen and appeared to have shrunk (Test Nr 2).

e. The hood, with hood cover installed, could not be raised without first unsnapping the seven snap fasteners which held the cover to the brush guard (par 35, Annex B).

f. During operation on highways, secondary roads, and on cross-country trails, the door glass panels would slide open. This was considered a safety hazard as it distracted the driver. It also permitted an uncomfortable amount of cold air to enter the vehicle (par 32, Annex B).

g. The personnel heater directed an uncomfortable amount of heat on the driver's right leg and on the assistant driver's left leg (par 8, Annex B).

h. Because the air intake box is located to the rear of the left door, it was difficult for the driver to converse over the roar of the inrushing air with persons outside the vehicle. He had to dismount to hear or give instructions (par 33, Annex B).

k. A safety hazard developed when the windshield became frosted as it became difficult for the driver to see (Test Nr 2).

l. During highway, secondary, and cross-country operation, the door latch plungers would gradually work out of the recess in the striker plate, and the doors would unexpectedly open. This constituted a safety hazard. A chain latch was fastened between the door and the door pillar post (par 13, Annex B).

m. There were no safety hazards experienced in the operation of other components of the test kit.

n. Operating instructions contained in TB 9-2320-218-10/1 were adequate for arctic operations.

Test Nr 5 - Maintenance

1. PURPOSE:

- a. To determine whether maintenance of the test kit could be accomplished readily.
- b. To accumulate parts usage data.
- c. To accumulate data pertaining to man-hours expended in maintenance.
- d. To review the installation and maintenance manuals and bulletins included in the maintenance package for the purpose of recommending necessary changes, deletions, additions, and corrections.

2. METHOD: Using appropriate tools and skills, all necessary authorized maintenance was performed on the test kit in accordance with instructions contained in TB 9-2320-218-10/1, TB 9-2320-218-21/1, and TM 9-2320-218-20. First echelon maintenance was performed in an unsheltered area during the winter by operator personnel attired in appropriate arctic winter clothing including arctic handwear. Scheduled second echelon maintenance was performed by second echelon maintenance personnel outdoors under field conditions during the winter to the extent sufficient to determine whether it could be accomplished under those conditions. Data were recorded with respect to the following:

- a. Average man-hours required to perform first echelon maintenance.
- b. Man-hours required to perform second echelon maintenance both indoors and under field conditions.
- c. Total man-hours expended in maintaining the test kit, categorized as to scheduled (first and second echelon) and unscheduled (second echelon and field) maintenance.
- d. Difficult and time consuming maintenance operations.
- e. Adequacy of organizational tools for performance of second echelon maintenance.
- f. Adequacy of on-vehicle (M151) tools to perform necessary first echelon maintenance on the test kit.
- g. Adequacy of maintenance package with respect to installation instructions and performance of first and second echelon maintenance.
- h. Parts expended in maintaining the test kit.

3. RESULTS:

a. The test kit required a total of 8.4 man-hours to perform all first echelon maintenance for 10,899 miles of vehicle operation and 575 hours of heater operation. The average time (one operator) required to perform first echelon maintenance was 0.082 man-hours.

b. The total man-hours categorized as to scheduled first and second and unscheduled second and field maintenance required to maintain the test kit are listed below:

Echelon	Scheduled (Man-hours)	Unscheduled (Man-hours)
First	8.40	
Second	1.86	12.00
Field		15.00
Totals	10.26	27.00

c. Scheduled second echelon maintenance could be performed equally well both indoors and under field conditions. The average time (one mechanic) required to perform scheduled second echelon maintenance indoors or under field conditions was 0.62 man-hours.

d. There were no difficult or time consuming maintenance operations except that the solenoid mechanism of the diverter actuator could not be adjusted. This was a field maintenance repair (Test Nr 6).

e. Organization tools were adequate for the performance of second echelon maintenance.

f. On-vehicle (M151) tools were adequate to perform first echelon maintenance on the test kit.

g. A maintenance package was not provided initially with the test kit (par 17, Annex B); however, a maintenance package consisting of the following publications was obtained from the developing agency during the test.

TB 9-2320-218-10/1
TB 9-2320-218-20/1
TM 9-2320-218-20
MWO 9-2320-218-30/2

h. With the exception of (1) and (2) below, data contained in above listed publications were adequate for installation and maintenance of the test kit.

(1) The floor drilling diagram on page 10 of MWO 9-2320-218-30/2 did not provide correct measurements for drilling the floor panel for

the installation of the gasoline heater and fuel pump bracket. A corrected diagram was made, and the heater and fuel pump bracket were installed (par 2, Annex B).

(2) Figure 8, TB 9-2320-218-10/1 and Figure 1 and View A (page 15), TB 9-2320-218-20/1 show the hose (10885015) between the heater and the defroster diverter (8707546) to be located to the right of the transmission tunnel of the M151. In this position, when the assistant driver's seat is tilted forward, the left frame of the seat crushes the hose (par 3, Annex B).

i. No parts were expended in maintaining the test kit.

Test Nr 6 - Durability and Reliability:

1. PURPOSE: To determine whether the test kit is durable and reliable when installed on the Truck, Utility, $\frac{1}{4}$ -Ton, 4x4, M151.

2. METHOD:

a. This test was conducted concurrently with all other tests.

b. The M151 on which the test kit was installed was operated during all types of weather and at the temperatures which were available during the test season. The following data were recorded:

(1) Vehicle miles accumulated with the test kit installed to include type roads and weather conditions.

(2) Hours of heater operation

(3) All defects, malfunctions, and failures which adversely affected operation of the test kit.

3. RESULTS:

a. The test kit-M151 vehicle combination was driven through snow storms, winds with velocities to 60 mph, through falling mist, and was operated during Exercise Great Bear.

b. The following mileages were accumulated over the type terrain indicated below during ambient temperatures ranging from 21°F to -62°F:

<u>Terrain</u>	<u>Total Miles</u>
Highway	8,439
Secondary roads	1,217
Cross-country	1,243
Total	10,899

c. The personnel heater was operated for a total of 575 hours.

d. Defects, malfunctions, and failures which adversely affected operation of the test kit are listed below:

(1) A circuit breaker was not provided for the damper actuator. As a result, the solenoid coil burned out during initial installation (par 6, Annex B).

(2) The felt tracking for the door glass panels loosened and jammed against the panels (par 26, Annex B)

(3) The handles for the door glass panels loosened from the glass and could not be replaced (par 29, Annex B).

(4) The right and left door hinges tore loose from the door panels (par 12, Annex B).

(5) The inlet tube to the plastic battery box cover broke loose (par 14, Annex B).

(6) The eyelets in the front of the hood cover caught on and bent the snap fasteners located across the top front of the brush guard (par 15, Annex B).

(7) The rubber insulation glued to the battery box cover and the top of the gas tank came loose (par 16, Annex B).

(8) The flap on the brush guard could not be fastened at ambient temperatures below -10°F (Test Nr 2).

(9) The defrosters directed an excessive amount of hot air on the windshield. As a result, three windshield panels were cracked and had to be replaced (Test Nr 3).

(10) The door latches could not be relied on to keep the doors from opening unexpectedly. Safety chains had to be installed (Test Nr 4).

(11) The damper actuator in the hot air duct to the batteries could not be adjusted causing the battery electrolyte to boil out of the batteries and the caps melted (par 9, Annex B).

(12) On one occasion, the fuel filter for the personnel heater failed to adequately filter lint from the gasoline supply. As a result, the heater alternately turned off and on (par 34, Annex B).

ANNEX B

FINDINGS

DEFICIENCY/SHORTCOMING

SUGGESTED CORRECTIVE ACTION

REMARKS

SECTION I

This section contains deficiencies requiring elimination in order to make the item acceptable for use on a minimum basis.

1. Both door glasses were broken upon receipt of the test kit.
Insure that the Winterization Kit, $\frac{1}{4}$ -Ton, M151 is properly packaged for shipment.
Test Nr 1, Report of Equipment Failure Nr 1.
2. The floor drilling diagram page 10, MWG 9-2320-218-30/2 was incorrect.
Provide correct diagram.
Test Nr 5, Report of Equipment Failure Nr 3.
3. The left part of the assistant driver's seat frame struck the defroster hose when seat was tilted forward.
Provide a suitable mounting of the defroster hose that will eliminate interference between the hose and assistant driver's seat.
Test Nr 5, Report of Equipment Failure Nr 16.
4. Weather strip material provided did not properly seal component panels or assembled kit to the body of the $\frac{1}{4}$ -ton M151.
Provide adequate seal strips for the hardtop enclosure; kit. Use of sponge rubber is suggested.
Test Nr 2, Report of Equipment Failure Nr 18.
5. The damper actuator assembly sole-noid failed.
Provide properly adjusted damper actuator assembly.
Test Nr 1, Report of Equipment Failure Nr 9.
6. The electrical components of the damper actuator assembly were not protected by a circuit breaker.
Provide a circuit breaker for the damper actuator assembly.
Test Nr 8, Report of Equipment Failure Nr 10.

DEFICIENCY/SHORTCOMING

SUGGESTED CORRECTIVE ACTION

REMARKS

SECTION I

7. The door latch plungers did not automatically engage the latch plate.

Provide doors with a spring loaded latch plunger which will latch independently of the door handles.

Test Nr 4, Report of Equipment Failure Nr 15.

8. The heater diverter assembly did not evenly distribute heat within the M151 personnel compartment.

Provide a diverter assembly that will distribute heat evenly within the front and rear of the personnel compartment.

Test Nr 4, Report of Equipment Failure Nr 34.

9. The battery compartment heat damper actuator failed to close off the hot air to the battery compartment.

Provide properly adjusted actuator assembly.

Test Nr 6, Report of Equipment Failure Nr 23.

10. The defrosters failed to clear ice from the outer surface (-34 to -28°F) and failed to completely keep the inner surface of the windshield frost free at ambient temperatures of -20° to -62°F.

Unknown (sealing the overlapping door glass helped, but only 1/3 of the windshield could be kept frost free at temperature ranges of -47°F to -62°F).

Test Nr 2, Report of Equipment Failure Nr 38.

11. Heat supplied from the personnel heater and ducted to the defroster diverter caused the right and left windshields to crack.

Provide a suitable defroster diverter for the personnel heater

Test Nr 3, Report of Equipment Failure Nr 24.

12. The lower door hinge tore away from the door hinge support panel, and the upper door hinge on the left door loosened from the hinge support panel.

Provide durable door hinge supports for the doors of the aluminum hardtop enclosure kit.

Test Nr 6, Report of Equipment Failure Nrs 25 and 28.

DEFICIENCY/SHORTCOMING

SUGGESTED CORRECTIVE ACTION

REMARKS

SECTION I.

13. The door latch plunger and striker plate assembly failed to lock the doors in a closed position.
Provide a satisfactory method of latching and locking the doors of the hardtop enclosure.
14. The hot air inlet tube on the battery box cover broke loose from the cover.
Provide a durable inlet tube for the battery box cover.
15. The eyelets on the hood cover caught and bent the fasteners. The fasteners were broken.
Fasten hood cover to hood rather than front grill.
16. Insulation material on the battery compartment cover and the gas tank came loose.
Provide a satisfactory method of fastening the insulation.

B, 3

SECTION II.

This section lists those deficiencies and shortcomings of the item which were discovered during test and satisfactorily corrected prior to completion of the test. They no longer represent a defect in the item tested. The correction must be applied to the production model of this item.

17. A maintenance package was not supplied as part of the winterization kit.

Test Nr 4, Report of Equipment Failure Nr 21.
Test Nr 6, Report of Equipment Failure Nr 26.

Test Nr 6, Report of Equipment Failure Nr 29.

Test Nr 6, Report of Equipment Failure Nr 30, and 36.

SECTION III

This section lists shortcomings which should be corrected, if it can be done without unduly complicating the item or inducing another undesirable characteristic either concurrent with elimination of the deficiencies in Section I, or in production engineering, or by product improvement.

DEFICIENCY/SHORTCOMING

SUGGESTED CORRECTIVE ACTION

REMARKS

SECTION III

26. The felt used to line the left and right side tracks of the door window frames failed.
- Provide a durable lining and track for the door glass panels.
- Test Nr 6, Report of Equipment Failure Nr 14.
27. One and one-half inches of the front and rear door glass sections overlapped and made cleaning difficult.
- Provide door windows which can be cleaned easily.
- Test Nr 4, Report of Equipment Failure Nr 17.
28. Frost collects on the interior of the aluminum hardtop enclosure.
- Provide thermal barrier insulating material for the aluminum hardtop enclosure.
- Test Nr 2, Report of Equipment Failure Nr 33.
29. The door glass handles separated from the two sliding glass panels.
- Provide simple handles or finger catches for sliding door glass panels.
- Test Nr 6, Report of Equipment Failure Nr 22.
30. The air intake hose decreased storage and passenger space. The hose was pulled loose from heater by passengers entering or leaving vehicle.
- Unknown.
- Test Nr 3, Report of Equipment Failure Nr 40.
31. The flap on the brush guard cover could not be fastened at ambient temperatures below -10°F.
- Provide a method of fastening the flap for temperatures below -10°F.
- Test Nr 2, Report of Equipment Failure Nr 31.
32. Sliding glass door panels slid open when vehicle was in motion.
- Provide a means of fastening the sliding door glass panels.
- Test Nr 4, Report of Equipment Failure Nr 32.
33. Noise created by air rushing into air intake was excessive. Intake was located close to driver.
- Relocate air intake.
- Test Nr 4, Report of Equipment Failure Nr 39.

DEFICIENCY/SHORTCOMING

SUGGESTED CORRECTIVE ACTION

REMARKS

SECTION III

34. The fuel filter failed to adequately filter fuel entering the fuel control valve.
35. The hood cover had to be unsnapped to raise the hood.
36. The engine priming system was considered to be non-essential.

- Unknown.
- Fasten hood cover to hood
- Eliminate the engine priming system.

Test Nr 6, Report of Equipment Failure Nr 27.

Test Nr 4, Report of Equipment Failure Nr 12.

Test Nr 2, Report of Equipment Failure Nr 41.



**US ARMY ARCTIC TEST BOARD
FORT GREELY, ALASKA**

PROJECT NR ATB 2-232

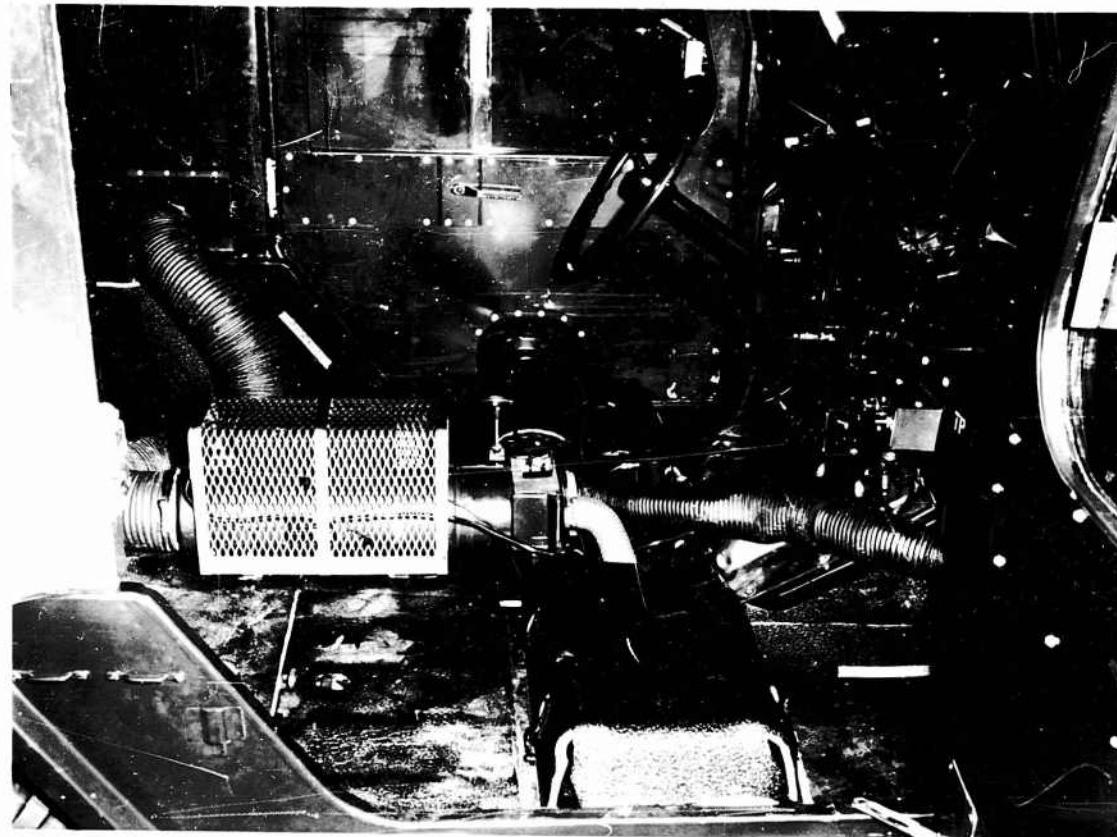
5 DEC 61

NEGATIVE NR 104-1

SERVICE TEST OF WINTERIZATION KIT
FOR TRUCK, UTILITY, $\frac{1}{4}$ -TON, 4X4, M151

TEST KIT (HARDTOP ENCLOSURE) MOUNTED ON M151 $\frac{1}{4}$ -TON TRUCK

C.1



US ARMY ARCTIC TEST BOARD

FORT GREELY, ALASKA

PROJECT NR ATB 2-232

11 JUN 61

NEGATIVE NR 56-21

SERVICE TEST OF WINTERIZATION KIT
FOR TRUCK, UTILITY, $\frac{1}{4}$ -TON, 4X4, M151

INSTALLATION OF GASOLINE HEATER IN M151 $\frac{1}{4}$ -TON TRUCK
(FRONT SEATS REMOVED)

ANNEX D - COORDINATION OF PLAN
UNITED KINGDOM AND CANADIAN COMMENTS
PLAN OF TEST - PROJECT NR ATB 2-232

1. The British Liaison Officer, USCONARC, did not reply.
2. The Canadian Liaison Officer, USCONARC, did not reply.